REMARKS

Overview of the Office Action

Claims 1-2 and 14-17 have been rejected under 35 U.S.C. 102(e) as anticipated by U.S. Patent No. 6,504,180 (Heremans).

Claims 18-21, 35 and 37 have been rejected under 35 U.S.C. 102(b) as anticipated by U.S. Patent No. 4,122,486 (Ono).

Claims 18-20, 30, 31, 34 and 35 have been rejected under 35 U.S.C. 102(b) as anticipated by U.S. Patent No. 6,111,272 (Heinen).

Claims 3, 4, 12 and 33 have been rejected under 35 U.S.C. 103(a) as unpatentable over Heremans in view of U.S. Patent No. 6,291,839 (Lester).

Claims 5-11 and 13 have been rejected under 35 U.S.C. 103(a) as unpatentable over Heremans.

Claims 22-29 and 36 have been rejected under 35 U.S.C. 103(a) as unpatentable over Ono.

Claim 32 has been rejected under 35 U.S.C. 103(a) as unpatentable over Ono in view of U.S. Patent No. 6,515,310 (Yamazaki).

Status of the claims

Claims 1, 3-6, 9-10, 18, 21-24, 26 and 36 have been amended.

Claims 2, 8, 20, 30 and 35 have been canceled.

Claims 1, 3-7, 9-19, 21-29, 21-34 and 36-37 remain pending.

Rejection of claims 1-2 and 14-17 under 35 U.S.C. §102(e)

The Office Action states that Heremans teaches all of Applicants' recited elements.

Independent claim 1 has been amended to recite a radiation-emitting semiconductor device that includes a reflective layer or interface, and a multilayer structure that includes an active, radiation-generating layer, a first main area coupled to the reflective layer or interface, and a second main area remote from the first main area for coupling out the radiation generated in the active, radiation-generating layer, wherein the multilayer structure is an epitaxial layer structure, the semiconductor device is free of a deposition substrate of the multilayer structure, a region of the multilayer structure that adjoins the second main area of the multilayer structure is patterned one- or two-dimensionally to form convex elevations, and a height (h1) of the elevations is at least as large as a height (h2) of an unpatterned region of the multilayer structure that is between the active, radiation-generating layer and the elevations. Support for these amendments can be found in original claims 2 and 8 and in Fig. 5 of Applicants' published specification.

Heremans fails to teach or suggest "a region of the multilayer structure that adjoins the second main area of the multilayer structure is patterned one- or two-dimensionally to form convex elevations, and a height (h1) of the elevations is at least as large as a height (h2) of an unpatterned region of the multilayer structure that is between the active, radiation-generating layer and the elevations", as now recited in Applicants' amended claim 1.

With respect to the subject matter of now-cancelled dependent claim 8, which has now been incorporated into independent claim 1, the Examiner concedes that Heremans fails to

disclose that the height of the elevations is at least as large as the height of the plane region of the multilayer structure between the active, radiation-generating layer and the elevations.

The Examiner asserts, however, that it would have been obvious to modify Heremans to have the height of the elevations be at least as large as the height of the plane region of the multilayer structure between the active, radiation-generating layer and the elevations since it has been held that discovering the optimum value of a result effective variable involves only routine skill in the art. Applicants disagree.

Heremans discloses a device for emitting radiation at a predetermined wavelength. The device of Heremans includes a cavity with an active layer in which the radiation is generated by charge carrier recombination. The edges of the device define the region or space for radiation and/or charge carrier confinement. The edge of the device has a substantially random grating structure and can extend along at least one edge of a waveguide forming part of the radiation emitting device. The device can include a cavity that includes a radiation confinement space that includes confinement features, which confine the charge carriers to a subspace that is smaller than the radiation confinement space within the cavity. The device can include at least two edges forming, in cross-section, a substantially triangular shape. The angle between these two edges is smaller than 45 degrees. At least one of the two edges has a transparent portion (see Abstract of Heremans).

The device of Heremans includes a multilayer structure that is based on AlGaAs (see the table in col. 16 of Heremans) and includes an active layer 10. On one side, the device of Heremans includes a transparent window 41, which has a roughened surface structure with a substantially random grating structure (see Fig. 12 and col. 16, lines 22-24 of Heremans). The surface is roughened with the aid of polystyrene spheres having a final diameter of 350 nm by

etching to a depth of 170 nm (see col. 18, lines 4-25 of Heremans). This results in the formation of cylindrical pillars with a height of 170 nm (see col. 18, line 24 of Heremans). However, the height of the epitaxial multilayer structure is larger than 1000 nm on each side of the active layer 10 (see the table in col. 16 of Heremans).

This means that the height of the unpatterned region of the multilayer structure between the active layer 10 and the cylindrical pillars is about five times as great as the height of the cylindrical pillars. Thus, as conceded by Examiner, Heremans fails to teach or suggest a semiconductor device with convex elevations having a height that is at least as large as the height of an unpatterned region of the multilayer structure between the active layer and the elevations, as expressly recited in Applicants' independent claim 1.

According to M.P.E.P. §2144.05 (II B), "a particular parameter must first be recognized as a result effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation".

Heremans is absolutely silent with respect to the relative heights of the elevations and the heights of a non-patterned region of the multilayer structure between the active layer and the elevations. Neither does Heremans contain any disclosure or suggestion that this height relationship has any bearing on the effectiveness or functionality of its device. These heights are not parameters that are recognized by Heremans, or otherwise in the art, to be result effective variables. Heremans does not provide any teaching for a person skilled in the art to set or vary or experiment with the height of a non-patterned region between the active layer and the height of the elevations to a specific value in order to improve the coupling-out efficiency of a semiconductor chip. Thus, there is nothing in the art that recognizes or teaches that this

relationship is a result effective variable and, thus, that routine experimentation might be used to determine or set this relationship.

Consequently, the Examiner's assertion that Applicants' recited heights h1 and h2 are result effective variables that involve only routine skill in the art is unsupported and incorrect. Determination of the optimum or workable relationship for Applicants' heights h1 and h2 cannot properly be characterized as merely the result of routine experimentation because the variable to be optimized has not at all been identified in Heremans, or elsewhere in the art, as a result effective variable.

In contrast to the teachings of Heremans, Applicants' published specification expressly discloses the relevance of the relative heights h1 and h2 in conjunction with Fig. 3B (see paragraphs [0045] and [0046] of Applicants' published specification).

Applicants further submit that the claim recitation that the height h1 of the convex elevations are at least as large as the height (h2) of an unpatterned region of the multilayer structure that is between the active, radiation-generating layer and the elevations is also not a simple design choice.

According to M.P.E.P. §2144.04 (IV A) "where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device".

Applicants' recited height h1 of the patterned region and height h2 of the unpatterned region improves the coupling-out efficiency of Applicants' claimed device when these heights are chosen as recited in claim 1. Thus, Applicants' claimed device does, in fact, perform differently than the device of Heremans.

Applicants' recited heights h1 and h2 are therefore neither an obvious optimization of a result effective variable nor an arbitrary design choice. Rather, Applicants' recited heights h1 and h2 constitute a purposeful selection of a relevant parameter, of which Heremans is silently unaware and expresses no concern, for achieving improved coupling-out efficiency of the claimed device. The disclosure of Heremans fails to provide any teaching whatsoever with respect to such a purposeful selection of the heights h1 and h2.

Heremans, therefore, fails to teach or suggest "a height (h1) of the elevations is at least as large as a height (h2) of an unpatterned region of the multilayer structure that is between the active, radiation-generating layer and the elevations", as expressly recited in Applicants' amended claim 1. Accordingly, claim 1 is deemed to be patentable over Heremans under 35 U.S.C. §102(e).

Claim 2 has been canceled. Claims 14-17, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, deemed to be patentably distinct over Heremans for at least those reasons discussed above with respect to claim 1.

Rejection of claims 18-21, 35, and 37 under 35 U.S.C. §102(b)

The Office Action states that Ono teaches all of Applicants' recited elements.

Independent claim 18 has been amended to recite a radiation-emitting semiconductor device that includes a substantially planar reflective layer or interface, where the reflective layer is applied on a carrier substrate or where the reflective interface is formed by a carrier substrate. Applicants' recited semiconductor device further includes a multilayer structure that includes an active, radiation-generating layer, a first main surface coupled to the reflective layer or interface, and a second main surface remote from the first main area for coupling out the radiation

generated in the active, radiation-generating layer. Applicants' recited semiconductor device still further includes a transparent layer disposed between the first main surface of the multilayer structure and the reflective layer or interface. The transparent layer is patterned one- or two-dimensionally, wherein the multilayer structure is an epitaxial layer structure, and the semiconductor device is free of a deposition substrate of the multilayer structure; and wherein the transparent layer includes convex elevations. The convex elevations taper in a direction away from the first main surface of the multilayer structure of the reflective layer or interface.

Support for these claim amendments can be found in original claims 20, 30 and 35, and in Fig. 5 of Applicants' published specification.

Ono fails to teach or suggest "the reflective layer being applied on a carrier substrate or the reflective interface being formed by a carrier substrate", "a transparent layer disposed between the first main surface of the multilayer structure and the reflective layer or interface", and "wherein the transparent layer comprises convex elevations, the convex elevations tapering in a direction away from the first main surface of the multilayer structure of the reflective layer or interface", all as recited in Applicants' now amended claim 18.

According to the Office Action, Ono fails to teach or suggest the subject matter of original claim 30, which recites "the reflective layer being applied on a carrier substrate or the reflective interface being formed by a carrier substrate", and which recitation is now incorporated in amended claim 18. Therefore, Ono fails to teach or suggest all the features recited in Applicants' amended claim 18.

The Examiner asserts that the p+ -type crystal layer 22 of Ono corresponds to Applicants' recited transparent layer, and that the Au layer 29 of Ono corresponds to Applicants' recited reflective layer. Applicants disagree.

According to Applicants' independent claim 18, the multilayer structure includes an active, radiation generating layer, and the transparent layer is disposed between the first main surface of the multilayer structure and the reflective layer/interface.

According to Ono, the pn-junction 25 is the light emitting (i.e. active), radiation generating layer (see claim 1 and col. 4, lines 15-16 of Ono). Since the p+ -type crystal layer 22 is disposed on the side of the pn-junction 25 which is remote from the Au layer 29, the p+ -type crystal layer 22 is not disposed between an epitaxial multilayer structure comprising an active, radiation generating layer and a reflective layer, as is recited in Applicants' claim 18. For this reason, the p+ -type crystal layer 22 of Ono cannot correspond to Applicants' recited transparent layer.

Further, the first main surface of Applicants' recited multilayer structure is coupled to the reflective layer/interface. Therefore, Applicants' first main surface is the main surface of the multilayer structure that faces the reflective layer/interface.

According to Fig. 2c and col.4, lines 10-13 of Ono, the surface of the epitaxial layer stack, which faces the Au layer 29, is the surface of n+ -type layer 24. Thus, the p+ -type crystal layer 22 is on the side of n+ -type crystal layer 24 that is remote from the Au layer 29, and is not disposed between the n+ -type layer 24 and the Au layer 29 of Ono. Therefore, for this additional reason, the p+ -type crystal layer 22 of Ono cannot correspond to Applicants' recited transparent layer.

Ono thus clearly fails to teach or suggest "a transparent layer disposed between the first main ~~area~~ surface of the multilayer structure and the reflective layer or interface", as recited in Applicants' claim 18.

The Examiner cites Fig. 2c of Ono and asserts that the p+ -type crystal layer 22 includes

convex elevations and that these elevations anticipate Applicants' recited convex elevations on the transparent layer. Applicants disagree.

As discussed in detail above, the p+ -type crystal layer 22 of Ono does not, and cannot, correspond to Applicants' recited transparent layer. Consequently, even if the p+ -type crystal layer 22 of Ono included such convex elevations, such convex elevations would not be part of a transparent layer as recited in Applicants' claim 18.

Furthermore, Ono teaches or suggests nothing regarding the presence of "convex elevations tapering in a direction away from the first main surface of the multilayer structure of the reflective layer or interface", as now recited in Applicants' claim 18.

Therefore, Ono fails to teach or suggest "wherein the transparent layer comprises convex elevations, the convex elevations tapering in a direction away from the first main surface of the multilayer structure of the reflective layer or interface", as recited in Applicants' amended claim 18.

In view of the foregoing, Applicants submit that Ono fails to teach or suggest the subject matter recited in independent claim 18. Accordingly, claim 18 is deemed to be patentable over Ono under 35 U.S.C. §102(b).

Claims 20 and 35 have been canceled. Claims 19, 21 and 37, which depend from independent claim 18, incorporate all of the limitations of independent claim 18 and are, therefore, deemed to be patentably distinct over Ono for at least those reasons discussed above with respect to claim 18.

Rejection of claims 18-20, 30, 31, 34, and 35 under 35 U.S.C. §102(b)

The Office Action states that Heinen teaches all of Applicants' recited elements.

Independent claim 18 has been amended as discussed in detail above.

Heinen fails to teach or suggest "the reflective layer being applied on a carrier substrate or the reflective interface being formed by a carrier substrate", "a transparent layer disposed between the first main surface of the multilayer structure and the reflective layer or interface", and "wherein the transparent layer comprises convex elevations, the convex elevations tapering in a direction away from the first main surface of the multilayer structure of the reflective layer or interface", all as recited in Applicants' amended claim 18.

The Examiner asserts that layer 11 of Heinen corresponds to Applicants' recited transparent layer and that Heinen's layer 4 corresponds to Applicants' recited reflective layer. Applicants disagree.

Heinen discloses an epitaxial layer stack 1 that includes a layer 11 of semiconductor material of one conductivity type, a layer 13 of semiconductor material of the other conductivity type, and an active layer 12 between layers 11 and 13 (see col. 8, lines 3-9 and lines 22-23 of Heinen). Thus, the layer 11 of Heinen is part of the epitaxial layer stack.

In contrast to Heinen, and according to Applicants' claim 18, the transparent layer is disposed between the first main surface of the multilayer structure and the reflective layer or interface. Therefore, Heinen fails to teach or suggest "a transparent layer disposed between the first main surface of the multilayer structure and the reflective layer or interface", as recited in Applicants' claim 18.

Further, the layer 4, which the Examiner asserts corresponds to Applicants' recited reflective layer, is part of the stack 1. As clearly shown in Fig. 1 of Heinen, the stack 1 sits on top of the substrate 2. Within the stack 1 of Heinen, the layer 4 is disposed on the active layer 12. The layer 4 of Heinen is neither applied on, nor formed by the substrate 2. Therefore, the

layer 4 cannot correspond to Applicants' recited reflecting layer as set forth in Applicants' claim 18.

As discussed above, claim 18 has been amended to incorporate the subject matter of claim 20, which recited "wherein the transparent layer comprises convex elevations". The Examiner's rejection of claim 20 fails to correctly address the recited subject matter of claim 20, and thus fails to point out where Heinen teaches or suggests this subject matter -- which it does not. Consequently, Heinen fails to teach or suggest "wherein the transparent layer comprises convex elevations", as now recited in Applicants' claim 18.

Moreover, Heinen also fails to teach or suggest anything whatsoever regarding "the convex elevations tapering in a direction away from the first main surface of the multilayer structure of the reflective layer or interface", as recited in Applicants' amended claim 18.

In view of the foregoing, Applicants submit that Heinen fails to teach or suggest the subject matter now recited in independent claim 18 and, accordingly, claim 18 is deemed to be patentable over Heinen under 35 U.S.C. §102(b).

Claims 20, 30 and 35 have been canceled. Claims 19, 31, and 34, which depend from independent claim 18, incorporate all of the limitations of independent claim 18 and are, therefore, deemed to be patentably distinct over Heinen for at least those reasons discussed above with respect to claim 18.

Rejection of claims 3, 4, 12 and 33 under 35 U.S.C. 103(a)

The Office Action states that the combination of Heremans and Lester teaches all of Applicants' recited elements.

As previously discussed, Heremans fails to teach or suggest the subject matter recited in Applicants' independent claim 1.

Because Heremans fails to teach or suggest the subject matter recited in amended claim 1, and because Lester fails to teach or suggest the elements of claim 1 that Heremans is missing, the addition of Lester to the reference combination fails to remedy the above-described deficiencies of Heremans.

Claim 3, 4, 12 and 33, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and each is, therefore, deemed to be patentably distinct over the combination of Heremans and Lester for at least those reasons discussed above with respect to independent claim 1.

Rejection of claims 5-11 and 13 under 35 U.S.C. §103(a)

The Office Action states that Heremans teaches all of Applicants' elements recited in independent claim 1.

As previously discussed, Heremans fails to teach or suggest the subject matter recited in Applicants' independent claim 1.

Claim 8 has been canceled. Claims 5-7, 9-11 and 13, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, deemed to be patentably distinct over Heremans for at least those reasons discussed above with respect to independent claim 1.

Rejection of claims 22-29 and 36 under 35 U.S.C. 103(a)

The Office Action states that Ono teaches all of Applicants' elements recited in these claims.

As previously discussed, Ono fails to teach or suggest the subject matter recited in Applicants' independent claim 18.

Claims 22-29 and 36, which depend from amended independent claim 18, incorporate all of the limitations of independent claim 18 and are, therefore, deemed to be patentably distinct over Ono for at least those reasons discussed above with respect to claim 18.

Rejection of claim 32 under 35 U.S.C. 103(a)

The Office Action states that the combination of Ono and Yamazaki teaches all of Applicants' recited elements.

As previously discussed, Ono fails to teach or suggest the subject matter recited in Applicants' independent claim 18.

Because Ono fails to teach or suggest the subject matter recited in amended claim 18, and because Yamazaki fails to teach or suggest the elements of claim 18 that Ono is missing, the addition of Yamazaki to Ono fails to remedy the above-described deficiencies of Ono.

Claim 32, which depends from independent claim 18, incorporates all of the limitations of independent claim 18 and is, therefore, deemed to be patentably distinct over the combination of Ono and Yamazaki for at least those reasons discussed above with respect to independent claim 18.

Conclusion

In view of the foregoing, reconsideration, withdrawal of all rejections, and allowance of all pending claims are respectfully solicited.

Should the Examiner have any comments, questions, suggestions, or objections, the Examiner is respectfully requested to telephone the undersigned to facilitate an early resolution of any outstanding issues.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN PONTANI LIEBERMAN & PAVANE LLP

By _____

Lance J. Lieberman
Reg. No. 28,437
551 Fifth Avenue, Suite 1210
New York, New York 10176
(212) 687-2770

Dated: July 27, 2009